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August 20, 2013

Dear Chairwoman Clyburn, Commissioner Rosenworcel, and Commissioner Pai:

We are pleased to attach a report of the year's activities of the FCC's Open Internet Advisory Committee, created to advise the Commission how to enforce, reflect upon, and improve its Open Internet Report and Order, approved in 2010.[1]

Given our diverse membership, and the correspondingly broad set of viewpoints and interests represented, we knew that achieving consensus on concrete changes to the Open Internet Report and Order would be a tall order. In order to delve into real issues, the Committee sought to clearly articulate viewpoints where judgments diverged, and to help flesh out some of the more loaded terms in the OIO, such as "specialized services," which underlies one of the exceptions to the rules for wireline service providers.

Accordingly, the documents produced by each of our Committee working groups are best understood as attempts to lay out a useful spectrum of opinions associated with particular stakeholders, rather than to come to clear conclusions about next steps. Our work also makes note of areas in which more research or information-gathering by outside parties or Commission staff would be helpful.

The Committee's work was undertaken through four working groups which met by teleconference and through e-mail lists, as well as in-person meetings over the course of the year in Washington, DC; Cambridge; Palo Alto; and Chicago. These gatherings included meetings of the full Committee, made available to the public on location and by webcast.

We thank all of the committee members and the FCC staff who devoted time to producing this report and the work it describes. We hope it will help define the landscape in which the OIO is taking place, informing judgments in this space for the months and years to come.

It is the consensus of the Committee to seek your feedback on this work, with an eye towards a constructive agenda and priorities for the next year, before we undertake further major work.

Sincerely,

Jonathan Zittrain
Open Internet Advisory Committee Chair

David Clark
Open Internet Advisory Committee Vice-Chair

[1] "The Committee, to be created in consultation with the General Services Administration pursuant to the Federal Advisory Committee Act, will be an inclusive and transparent body that will hold public meetings. It will be comprised of a balanced group including consumer advocates; Internet engineering experts; content, application, and service providers; network equipment and enduser-device manufacturers and suppliers; investors; broadband service providers; and other parties the Commission may deem appropriate. The Committee will aid the Commission in tracking developments with respect to the freedom and openness of the Internet, in particular with respect to issues discussed in this Order, including technical standards and issues relating to mobile broadband and specialized services."

Open Internet Advisory Committee 2013 Annual Report

Open Internet Advisory Committee
Federal Communications Commission

Released August 20, 2013

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Brad Burnham, Founding Partner, Union Square Ventures

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Executive Summaries

1. Data Caps Report (Economic Impacts working group)

The report aims to analyze data caps in the context of the Open Internet Report and Order. The Open Internet Report and Order discusses usage-based pricing (UBP), but does not expressly mention data caps except by implication in that data caps can be considered a form of UBP. The Order left open the possibility of many experiments in business models and pricing. Moreover, the Internet had evolved over time, and the Order anticipated that the Internet would continue to evolve in unexpected ways. The Order set up the advisory group to consider whether aspects of the Order remain consistent in its effects on the Internet as the Internet evolves, and it is in that spirit that this conversation was undertaken.

The report seeks to clarify relevant terminology (e.g., cap, UBP, thresholds), identify a common fact-basis for discussion, analyze different perspectives, and identify unaddressed open questions.

The Report concludes that there is considerable variance and experimentation in the market by ISPs. It is difficult to interpret even the highest thresholds in the situations in which they arise, as there is no definitive public source on household usage per month to use as a benchmark. In addition, usage varies depending on ISP and technology. All public measurements show great skew in usage, and suggest that caps do not yet impact users other than the highest users.

The committee could reach only tentative conclusions. Although caps do not seem to be affecting a large number of US users now, the situation may change in the future, as user habits, supplier experimentation, vendor policy, and applications all change.

The report also elaborates on many of the key concerns of three stake-holders prominently identified in the Order, namely, users, broadband providers, and edge-providers.

The discussion about users focuses on user understanding about perceptions of caps and thresholds. The report concludes that this topic may require future monitoring, especially given the importance of consumer education to user perceptions of caps and thresholds. It is not yet apparent whether the issues in this topic are a transitory or permanent concern. The experience of ISPs with providing customers with tools to monitor or control data usage could also be valuable to insights about the perceptions of caps by consumers.

The discussion about broadband providers focuses on many divergent perspectives: whether data caps, tiers and related forms of UBP may encourage end users nearing that cap to act efficiently; whether data caps, tiers and related forms of UBP may spur efficiency and innovation on the delivery of services; whether data caps, tiers and related forms of UBP may help manage network growth; whether data caps, tiers and related forms of UBP might encourage heavy users to change their usage, and if so, in what way; whether data

caps may shape the future and conduct of other service providers (i.e. application developers).

The discussion about edge-providers considers how data caps, tiers and UBP can shape other providers of services in broadband ecosystem, e.g., entrepreneurs who provide applications, build web pages, and operate other services in the cloud. This part of the report identifies areas where ISPs and edge providers have different perspectives on open questions. It also examines competition policy for specialized services, recognizing that this topic is also covered by other working groups. In general, competition policy is concerned about situations where one firm, such as a broadband provider, supplies a service and also controls aspects affiliated with the cost, performance, and user-experience in a competing service, provided by an edge-provider. The report identifies how the ISP's perspective and the edge provider's perspective diverge on this topic. The report concludes the situation yields no easy answers in general, and, at a minimum, merits further monitoring.

In general, the committee concluded that these debates cannot be easily summarized in a brief set of bullets or summary paragraphs. The report contains many perspectives, as well as many open questions, and it identifies many issues that the FCC could further monitor.

2. FaceTime Case Study (Mobile working group)

Mobile broadband networks and traditional fixed networks are treated differently in the Open Internet Report and Order. Mobile broadband providers can, more easily than fixed providers, (1) block devices and applications which do not compete with voice or video telephony services of those providers and (2) discriminate in traffic service. Under certain circumstances, this differential treatment might obstruct a free and open Internet, which is why the Mobile broadband working group of the Open Internet Advisory Committee (OIAC) decided to investigate it through a case study. The working group looked into how AT&T restricted the cellular data usage of Apple's FaceTime application to only AT&T customers who used the "MobileShare" plans (instead of "unlimited" data plans). AT&T had disagreed with claims that it had violated the FCC's Open Internet Report and Order. In October 2012, during the working group's work, AT&T agreed on its own accord to support FaceTime on all of its tiered data plans.

The case study raises the following points:

1.) Pre-loaded applications, such as FaceTime, are more readily adopted than downloadable applications.

2.) FaceTime appears to have been designed in a way that generates a substantial amount of traffic and consumes more bandwidth than comparable applications (e.g., Skype), raising questions about whether FaceTime could feasibly adapt to congestion like other comparable applications.

3.) Restricting application usage to customers of a particular data subscription could actually, for the *benefit* of an open Internet, limit the number of users in an initial deployment of a new application, and limit the total amount of traffic.

4.) It is important to determine, in advance, *where* an application-management decision should be enforced and *who* should enforce such decisions (i.e. currently, a smart phone can block users from running an application).

The working group came to different opinions about AT&T's restriction of FaceTime usage on its network. Overall, the group agreed that blocking applications can discourage innovation, but that carriers should also have the freedom to manage their limited cellular network resources. More specifically, three main opinions emerged:

1.) Blocking an application from some users under a certain pricing plan could stifle the vibrancy of the mobile application market.

2.) AT&T's approach of permitting FaceTime on either Wi-Fi or within shared data plans was a logical way of managing network congestion.

3.) Encoding video frames at lower bit rates and adapting to changing network conditions (which Skype, unlike FaceTime, was capable of doing) is central to the use of video or voice calling applications.

3. Openness in the Mobile Broadband Ecosystem (Mobile Broadband working group)

This report analyzes how different actors in the mobile broadband ecosystem have each influenced Internet openness—as well as each other. These actors, not all of whom are subject to the Open Internet Report and Order, include:

1.) Mobile broadband providers (e.g. Verizon, AT&T, Spring, and T-Mobile);
2.) Device vendors (e.g. Apple and Samsung);
3.) Operating system developers (e.g. Apple iOS and Google Android);
4.) Network equipment vendors (e.g. Ericsson, Alcatel-Lucent, and Nokia-Siemens);
5.) Application developers and content providers

The mobile broadband system is theorized as a "virtuous cycle," in which fast and widely available networks encourage the creation of mobile devices to connect to these networks. In a "virtuous cycle," connectivity spurs innovation of applications and content, while encouraging users to adopt technologies and promoting further investment in the networks.

Multiple obstructions to the "virtuous cycle" exist. Most immediately, the nature of relationships between actors (listed above) might inhibit innovation and investment. Additionally, some companies hold more advantageous roles in world communications, while other companies hold significant roles in multiple parts of the mobile broadband ecosystem, which can lead to inconsistent incentives throughout the mobile ecosystem (see Section 1.2).

Four case studies demonstrate how relationships between actors within the mobile broadband ecosystem can affect the incentives of actors to invest and innovate:

1.) **App Stores**: Application stores, while useful for consumers, can also restrict the development of mobile applications by influencing which applications are made available under varying conditions. HTML5 technologies, however, may provide an alternative model to the current application store model by granting application developers access to device functionality (Section 2.1).

2.) **Service Agreements**: Mobile broadband providers can directly influence their customers' access to networked services. Different service agreements, which shape how customers are able to use their mobile devices, demonstrate tensions between the financial risks of providers and the flexibility of the user experience (Section 2.2).

3.) **Network Unfriendly Apps**: Mobile broadband networks face several challenges to minimizing network congestion, including (1) mobile applications written by software developers who are unaware of how high-level designs affect network usage or battery resources, (2) radio access networks with limited bandwidth, permitting one application to consume the majority of available resources, (3) the "bearer" that mobile devices must establish with the cell tower, and (4) the substantial upfront investment necessary to expand the capacity of a cellular network, since it is expensive to acquire spectrum licenses, deploy cell towers, and transition to new technologies (Section 2.3).

4.) **WiFi Offloading**: Mobile wireless data traffic is increasingly shifting from mobile broadband services to Wi-Fi access, which is cheaper and more accessible. Accordingly, Wi-Fi is becoming an essential part of providing mobile broadband services to users. However, users of Wi-Fi networks may experience interferences from users of neighboring access points. There are different categories of Wi-Fi solutions, each of which vary in their benefits and limitations. Licensed and unlicensed spectrum solutions should be considered in the future (Section 2.4).

The report puts forth the following conclusions:

1.) The FCC should consider all of the interactions between different actors in the mobile broadband ecosystem, even actors which are not subject to the Open Internet Report and Order.

2.) The FCC should pay attention to new trends, such as HTML5 and Wi-Fi offloading, both of which might increase competition as they impact the mobile landscape.

3.) Transparency, education, and competition will all contribute to a healthy mobile broadband ecosystem.

4. Specialized Services Report (Specialized Services working group)

The specialized services subgroup within the Open Internet Advisory Committee (OIAC) had two tasks: (1) to agree upon a definition of "specialized services," and (2) to provide the FCC with advice about how they should oversee broadband Internet access service (BIAS) in light of specialized services. Two concerns about specialized services in the Open Internet Report and Order (R&O) are: (1) that broadband providers might label services as specialized services that would normally be labeled as Internet access services to evade Open Internet rules; and (2) that

broadband providers might stop expanding network capacity allocated to broadband Internet access service to allow more space for specialized services. The Open Internet Report does not specifically examine the impact of specialized services.

Defining "specialized services" proved to be difficult for the subgroup, and the agreed upon definition of the term is meaningful only within the context of the R&O. In that context, the definition of "specialized services" sets a limit on which IP-based services are subject to the Open Internet rules, as services labeled as "specialized" are not subject to further regulation under the R&O. The working group concluded that the primary criteria proposed by the FCC to classify a service as specialized are that (1) it is not used to reach large parts of the Internet, and that (2) it is not a generic platform—but rather a specific "application level" service. The committee identified one additional criterion that might classify a service as specialized: capacity isolation from BIAS.

Three high-level principles concerning specialized services that the FCC should consider are:

- Regulation should not create a perverse incentive for operators to move away from a converged IP infrastructure
- A service should not be able to escape regulatory burden or acquire a burden by moving to IP
- Proposals for regulation should be tested by applying them to varying technologies used for broadband

Two approaches may be used to address the FCC's concern that specialized services might deter or limit investment in Internet services, though they both have risks associated with them. The first approach is that the FCC could define how much Internet service is "enough" and compare actual offerings to this minimum standard. However, this minimum standard will likely change over time as consumption habits shift. The second approach is that the FCC could examine what innovators can accomplish using specialized services compared with what they can accomplish with the public Internet, thereby revealing raw capacity as well as quality of service concerns.

In order to better understand the impact of specialized services on BIAS, and to understand when an Internet service is "good enough," this subgroup advocates for examining the quality of the user experience rather than technical parameters.

A. Appendix 1: IPTV

This paper examines the effects of video services (including IP-based video services) on broadband Internet access service (BIAS) and more generally in today's marketplace.

High Level Overview Of Broadband Access Network Architectures

The delivery of services over varied network architectures are surveyed, along with their potential repercussions for BIAS. This paper focuses on the access network, the portion of the network closest to the customer. Three commonly used access networks are (1) Hybrid Fiber Coax (HFC), typically used by modern cable systems, (2) Digital Subscriber Line (DSL), and (3) Passive Optical Networking (PON) based technology, typically used by telecommunications service providers.

Service Delivery Methods

Services provided over the aforementioned architectures generally include: video (provided by Multichannel Video Programming Distributors, or MVPDs), voice, and BIAS services, which typically use separate channels from the linear video services. Through IPTV, which is another means of service delivery, all services are carried using IP on the same physical network. Different methods of delivering services are chosen partially based on how closely connected the physical access path is to the various services.

Capacity Isolation

IP bandwidth in a household is dynamically allocated to different services, varying based on exact usage at a given time. However, capacity isolation is often used to ensure that IPTV bandwidth does not interfere with bandwidth used for BIAS services. The degree of isolation varies from service to service. This discussion is important because the degree of capacity isolation between a video service and BIAS service has implications for whether the video service should fall under the rules of the Report and Order.

Differences Between MVPDS' IP-Video and Over-the-Top Video

One consequence of higher-speed broadband networks has been the proliferation of Over the Top (OTT) video services, which deliver content through the BIAS service of the end user. Examples of OTT video services include Netflix, Amazon Prime, and Vudu. These services differ from IPTV systems in the following ways:

1.) Customer Expectations: Customer support is less extensive with OTT services than with MVPD services.
2.) System Design: OTT services are generally provided via a third-party content delivery network, while MVPD services are generally provided over a privately owned and managed network within the service provider's infrastructure.
3.) Equipment: OTT services can be accessed through a number of retail consumer devices in the home, such as computers, tablets, and special OTT devices from cable operators. MVPD services, however, are usually accessed on equipment leased from the service provider.
4.) Regulatory Requirements: Devices and video services of OTT providers are not subject to the same regulatory obligations as MVPD services (except for the requirement of closed captioning support).
5.) Video Quality: Unlike OTT services, MVPD services generally do not need adaptive coding to preserve the user experience.

B. Appendix 2: Third-Party Purchasing of Services for Their Customers

This case study examines how the increasing online service requirements on network performance might affect broadband Internet customers. The Internet provides "best effort" delivery of packets with no guarantees of delivery, delivery time of packets, and no guarantees one packet will have the same path/fate as the next. However, guaranteed quality of service from servers could be useful for customers. The subgroup explored four examples of third-party purchased quality of service:
1.) Establishing a separate specialized service to carry traffic between third-party services and its customers on the access ISP

2.) Prioritizing of OTT service traffic from certain third-party service providers amongst all general Internet traffic going to users over their Broadband Internet Access Service, either at the customer's request or at the third-party provider's request
3.) Establishing a dedicated core transit network to connect third-party service servers and access ISP networks
4.) Ensuring that there are open standards and best practices developed to support highly interactive traffic

In sum, the FCC should think readily about the distinction between challenges and solutions today, and opportunities tomorrow.

5. Open Internet Label Study (Transparency working group)

Introduction

This paper is concerned with transparency in the context of the Open Internet Report and Order, which mandates that fixed and mobile broadband providers be transparent in their management practices, performance characteristics, and terms and conditions of services. Specifically, this paper examines how ISPs present performance characteristics and pricing of their service offerings, and proposes a labeling system that would allow consumers to more easily compare services across companies.

Motivation

A voluntary open Internet labeling program would help consumers select Internet services by clearly delineating points of comparison between Internet service providers. The main reason for this program is that many consumers are confused about how and why to choose a particular wireless service provider. In addition to facilitating comparisons, labels would provide access to test sites and to third-party analyses of performance parameters to customers.

The Proposal

The suggested labeling program, through which data labels would correspond to each active service offering, would offer information pertaining to performance, price, and usage restrictions.

To partake in the suggested labeling program, ISPs would self-report data pertaining to upload speed and download speed (both reflecting the performance delivered by the ISP to a consumer's broadband modem), as well as the average monthly price over 36 months (which is designed to reflect both initial discounts or promotions and the long-term costs to the consumer). The label data could be published through (1) the ISP website, (2) an API provided by the ISP, or (3) periodic filings with a third party. Given the strengths and weaknesses of the respective publishing options, the working group recommends that the FCC pursue option (1).

Complexities

Various complexities nonetheless remain, including those related to service offerings (i.e. bundling and promotions), customers (i.e. customer location, variability of Internet usage throughout the day, and thresholds where customers do not see a difference between two offerings), and companies (i.e. quality of service, ease of use, and setup time), all of which must be taken into account in order to understand the label program.

Benefit
The label program could provide a number of benefits, including (1) awareness, (2) consumer clarity, (3) competition, (4) incentivized open Internet practices, (5) marketing, (6) improved customer loyalty, and (7) global applicability. However, the label program could also introduce problems, including (1) misled consumers, (2) increased governmental costs, and (3) slow adoption of the label program.

Summary
In summary, the Transparency Working Group encourages the FCC to collaborate with the industry to develop a voluntary labeling program, through which ISPs would provide information to consumers about their services.

Executive summaries were prepared by the Office of Professor Jonathan Zittrain.

Policy Issues in Data Caps and Usage-Based Pricing

FCC Open Internet Advisory Committee

Working Group on Economic Impacts of Open Internet Frameworks

Prepared for the meeting on July 9, 2013

The following report on Data Caps was prepared by the Economic Impacts working group in reaction to the press coverage and strong consumer sentiment regarding caps on data plans.

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Topics Covered

The report examines data caps within the context of the Open Internet Order, primarily in wire-line, non-specialized services Internet access, and seeks to bridge the divide between the vernacular conversation surrounding caps and the perspectives from various stakeholders. Thresholds, caps, and usage-based pricing have been implemented in a variety of ways. This study focuses on providing definitions and identifying concerns/questions, with an emphasis on highlighting concerns and questions of the Open Internet Advisory Committee members.

The working group has chosen to focus on caps, thresholds and usage-based pricing because of questions raised about caps and tiers in many public forums and working papers. The Order expressly approves of usage-based pricing and experiments in pricing. Some members are concerned that this report could be construed as the working group second-guessing the FCC's decision. The Order set up the advisory group to consider whether aspects of the Order remain consistent in its effects on the Internet as the Internet evolves, and it is in that spirit that this conversation was undertaken.

The report considers only one part of a larger topic in detail, while aspiring to summarize many important aspects of this topic. However, it recognizes that it may be difficult or impossible to be comprehensive. Accordingly, the study ends with a section of further reading.

Definitions

Specialized Services – The Order offers a rough definition on paragraph 112.

> "...services that share capacity with broadband Internet access service over providers' last-mile facilities, and may develop and offer other such services in the future. These 'specialized services,' such as some broadband providers' existing facilities-based VoIP and Internet Protocol-video offerings, differ from broadband Internet access service and may drive additional private investment in broadband networks and provide end users valued services, supplementing the benefits of the open Internet."

This report uses these terms merely for one pragmatic purpose, namely, to discuss the policy issues raised by data caps. Further discussion of the exact boundaries of this term are the province of the Specialized Services working group and are beyond the scope of this report.

Usage-based pricing - Usage-Based Pricing (UBP) takes many forms. It includes a continuum of practices from metering to discrete steps in price levels. In addition, volume-based pricing can discount or increase with volume. UBP appears in many economic settings and no single characterization will capture all these settings. For example, it describes metered pricing in electricity, as well as tiered pricing in cellular telephony. In general, UBP in the Internet context is based on amount of time online and/or volume of data transmitted. The working group uses UBP as a technical term that includes all form of charging functions that incorporate volume, whether linear or not.

Data caps - Data caps are often considered to be a form of UBP. The term "data cap" is characterized by several phenomena. In general, if a user is within a cap, he or she pays a set price. That is, the cap defines a limit on amount of data per month per household (today

expressed in gigabytes). Exceeding the cap could subject a household to alterations to its Internet access, possibly after one or more warnings, such as reduction of access speed, additional charges, suspension of service, or even termination of service.

The termination of service has received particular attention in public discussion, though to date, this appears to be a rare event, as noted below. A cap is rarely, if ever, a hard and fast ceiling on a customer's ability to access the network. A cap is usually better understood as a threshold after which the user is subject to a different set of conditions for access, such as movement to a higher priced tier, different product or different speeds. As discussed below, another way of thinking of this is as the boundary between different "tiers" of service.

The history of dial-up Internet access accounts for the present ambiguity in language. Historically caps referred to limitations on hours of use. It was quite common for dial-up ISPs to place capacity limitations based on hours of use of the ISP service per month, even for services sold as "unlimited." A common level for a cap was 100 to 120 hours of use per month. After exceeding that cap, certain ISPs would discontinue service altogether. Other ISPs used an early version of UBP instead and, rather than terminating service, would simply charge extra additional hour of service. One asserted basis for this practice was that UBP was needed to address capacity issues related to the fixed capacity of modem banks.[2]

Modern caps refer to limitations on downloading and uploading of data. Today, as the tables below show, hourly use is not restricted by any major ISP. Instead, thresholds, if they exist, pertain to monthly limits or tier thresholds on the total transmission and reception of data, and, moreover, the draconian features of historical caps, such as abrupt termination of service, are largely absent from the modern version. Within the United States, no major ISP stops providing service to consumers without notifying consumers and providing additional options in the way of tier upgrades or overage charges.

There are a variety of viewpoints about caps. Mirroring the different perspectives used throughout this document, the following perspectives may be helpful as a start to the discussion:

> *From the user viewpoint:* The viewpoints vary depending on if caps or thresholds are actually impacting the user. However, the difference between a high threshold and a cap may be a semantic distinction without a meaningful difference, particularly if the threshold appears to be abrupt, and there is little perceived difference between being terminated, and the alternatives, such as overage charges or throttling. Lack of consumer understanding of how a data caps are impacted by use of various services may impose mental transaction costs that could dissuade consumers from using Internet-delivered services – even if a user does not come near to exceeding a cap. These concerns are particularly acute if the user perceives little option to contract with alternative suppliers of Internet access. Additional questions also arise: can cap information be difficult to find,

[2] Providers justified these policies by noting that modem banks were dimensioned assuming statistical multiplexing and specific usage patterns. For a history of dial-up access business in the United States, see e.g., Greenstein, Shane. *2008.* "The Evolution of Market Structure for Internet Access in the United States." in William Aspray and Paul Ceruzzi, editors, *The Commercialization of the Internet and its Impact on American Business*, MIT Press. pp 47-104.

and relatively opaque to users, who may believe that they are contracting for unlimited Internet access?

From an ISP's viewpoint: Usage thresholds in most US broadband ISPs are set so high that they impact very few customers (around 1-2% depending on the ISP). Under most usage thresholds, a broadband user can successfully run many applications, stream video, download music, share photos, surf the web, play games online, etc. The concept of ultra-high end thresholds is to ensure that the low end (1G-10G), average (15G-50G) and even the high end user (100G-250G) is not subsidizing the most extreme bandwidth user (250G-1000G+). Network resources are not unlimited, and the ISP's viewpoint is that, as the Open Internet Order explains, "lighter end users of the network" should not be forced "to subsidize heavier end users" who require more of a dedicated commercial level of service vs. residential broadband.

From an edge provider's viewpoint: (An edge provider is a firm that provides online content, applications, or services to end users.[3]) When users and edge providers exchange traffic, the traffic goes over an ISP's facilities. A high threshold or cap may represent an additional factor that shapes the ability of an edge provider to supply its service or conduct business with a user. If an ISP imposes a data cap or other form of UBP, this could affect user demand for the edge provider's service, which, in turn, may shape the ability of the edge provider to market and deliver its service. This is especially so if the ISP offers specialized services that compete with the edge provider, and for which a cap or other UBP does not apply.

The discussion will focus on the implications of these thresholds as one form of UBP, and expand on the different points of view. The study will occasionally use the phrase "caps" or "threshold," depending on context and point of view.

Two words of caution are warranted at the outset. First, assessment of caps is not synonymous with assessment of all forms of thresholds within UBP. This discussion leaves many other topics about UBP uncovered. Second, the study initially will focus on issues in the absence of competing specialized services. In the presence of specialized services, there are additional issues raised concerning selective applications of thresholds to some types of traffic, which will be discussed below.

The Report and Order on UBP

The Open Internet Report and Order discusses usage-based pricing, but does not expressly mention data caps except by implication in that data caps can be considered a form of UBP. The most direct mention of UBP is in Paragraph 72 of the Order:

> "Some commenters suggest that open Internet protections would prohibit broadband providers from offering their subscribers different tiers of service or

[3] See footnote 2 of the Order. The Order uses "... *'edge provider' to refer to content, application, service, and device providers, because they generally operate at the edge rather than the core of the network.*"

> from charging their subscribers based on bandwidth consumed. We are, of course, always concerned about anti-consumer or anticompetitive practices, and we remain so here. However, prohibiting tiered or usage-based pricing and requiring all subscribers to pay the same amount for broadband service, regardless of the performance or usage of the service, would force lighter end users of the network to subsidize heavier end users. It would also foreclose practices that may appropriately align incentives to encourage efficient use of networks. The framework we adopt today does not prevent broadband providers from asking subscribers who use the network less to pay less, and subscribers who use the network more to pay more."

The Order left open the possibility of many experiments in business models and pricing. Moreover, the Internet had evolved over time, and the Order anticipated that the Internet would continue to evolve in unexpected ways, including in pricing for mobile broadband services (see especially paragraph 94).

Competition

Data caps are a source of concern in settings where there are no or few substitutes for Internet access. That reduces the discipline affiliated with competitive markets. Limited competition gives a supplier the ability to make take-it or-leave-it offers to users, and users cannot leave for another supplier if they find the service or contracts unsatisfactory. As noted in the data section, there is no indication that ISPs are offering different policies in areas with limited competition.

Resolving any such question, however, requires defining the extent of competition, which, in turn, requires a precise definition of the size of the market. It is the typical first step in any textbook policy analysis. In practice, however, a precise definition can be elusive.[4]

That matters for discussions of caps, thresholds, and UBP. While there are a variety of issues with UBP, most of the issues with thresholds do not arise when the prices are low. Many interesting policy questions concern the highest thresholds and the biggest charges, especially those that (effectively) determine the difference between unlimited service and limited service.[5]

While that makes it seem like it might be possible to reduce many questions to a narrow issue, it turns out that even narrow questions contain challenges. For example, there is simply no general definition for "demand for high bandwidth," which varies by supplier, by geography, and technology. No simple definition – e.g., all markets for services above 5GB, 20GB or 50GB or some other arbitrary floor – will work in all settings. In addition, as will be shown below, because demand is growing rapidly, policy is shooting at a moving target, so it is also hard to describe a general rule for the size and scope of the market in which the policy issues arise.

Consider concerns about caps and thresholds that focus on the "high end," or users who consume a significant amount of data. There is a perception that users at the "high end" are more likely to

[4] See the National Broadband Plan, particularly chapters 3 and 4, for an extensive discussion of questions pertaining to defining the structure of the market. See http://www.broadband.gov/plan/.

[5] This section focuses on the policy issues at "the high end" for purposes of illustration. The discussion below will discuss further issues about thresholds across a range of bandwidth levels.

exceed caps and find no alternative source of Internet access that meets their high-usage demands. This usage pattern could be considered more typical of business-class users. However, even this perception is difficult to substantiate, partially because it is difficult to estimate what "high end" usage consists of now, or what it will consist of in the future. The size and definition of "high" is a moving target. It is also difficult to estimate what high or low end use consists of because estimations of usage distributions also vary widely, with no definitive standard. In addition, the lack of definitive data reflects real underlying variance in situations in which firms deploy wireline broadband in the United States – variance in access technology (cable, DSL and FTTH), vendors (different local pairings of rivals, if any), regulatory treatment, and geographic features (city/rural and flat/hilly). The National Broadband Plan discusses this variance extensively, as does the Order.

Growth in data traffic also reflects real underlying variance in the data-intensive applications that users deploy (e.g., YouTube, Hulu, Netflix, peer-to-peer, multiplayer gaming). Usage of data by these applications grows at different rates because there is variance in the rate of adoption – and intensity of use – of these and related applications. All of these variations confirm the need to refrain from sweeping generalities for all settings and times about the state of competitive alternatives.

Hence, there is no consensus on the definition for "high" either now or in the near future. This means that it's very difficult to draw conclusions about whether high end users would switch from wireline broadband providers with a lower cap to ones with a higher cap. This lack of data about even the user population, let alone their behavior in the marketplace makes it difficult to draw conclusions about the role of data caps in competition.

This does not mean it is impossible to discuss and analyze caps and related matters. However, it does imply that it is usually challenging to come to sweeping and general conclusions. This theme will arise in several places throughout the report.

Caps: The Facts

Many types of data charges exist in United States residential wireline Internet access. Table 1.1 shows data from an October 2012 article in GigaOm. Table 1.2 shows data collected by a working group member in February of 2013, based on publicly available data, which breaks out some of the thresholds by pricing tiers. The section will present these facts, and later sections will offer overlapping and competing interpretations.

Examination of the tables shows several things. First, the highest thresholds typically range between 150 and 300GB per month. Second, a number of ISPs do not have any caps at all. Third, many thresholds that resemble caps are part of a system of many-step thresholds, often within one pricing plan or tier. Fourth, some ISPs offer many tiers, and the highest thresholds vary by tiers. Fifth, when an overage charge arises (see appendix), firms tend to use similar levels, generally around $10 for 50 additional GBs beyond the threshold (See appendix. This is not reflected in the Tables).

These observations reinforce the conclusion that there is considerable variance and experimentation in the market by ISPs. Note, however, that these are observations of firms and

contracts, not subscribers. This table does not address questions about how much data most users actually consume and what thresholds, if any, most users actually face.

Table 1.1. Caps quoted in GigaOm

• ISP	Cap	• ISP	Cap
Comcast	300GB per month	Charter	100GB – 500 GB per month
AT&T	250GB or 150 GB per month	Frontier	No
TWC	No	Windstream	No
Verizon	No	SuddenLink	150GB to 350 GB per month
CenturyLink	150 GB per month to 250 GB per month	MediaCom	150 GB to 999 GB per month
Cox	30GB-400GB per month	Cable One	1GB, 50 GB and 100 GB per month
Cablevision	No	FairPoint	No
		Cincinnati Bell	No

Source: See http://gigaom.com/2012/10/01/data-caps-chart/.[6]

Table 1.2. Highest thresholds, Recent sampling of Company sites

Provider	Use Threshold - GBs[7]
Comcast	min 300 GB (increasing by speed tier)[8]
AT&T - U-Verse HSIA	250
AT&T – DSL	150
Time Warner Cable	None
Verizon - FiOS / DSL	None
CenturyLink - 1.5 Mbps	150
CenturyLink - >1.5 Mbps	250
Cox - Ultimate (100 Mbps)	400

[6] The article includes additional details on exceptions, tiers, and overages. The appendix consists of more recent and accurate data, and corrects several inaccuracies in this article.

[7] Gigabytes per month, unless otherwise noted.

[8] At the time of writing Comcast does not have any caps in place but is trialing two UBP plans. See appendix for further details.

Cox - Premier (25 Mbps)	250
Cox - Preferred (15 Mbps)	200
Cox - Essential (3 Mbps)	50
Cox - Starter (1 Mbps)	30
Cablevision	None
Charter - Lite & Express ( )	100
Charter - Plus & Max (30 Mbps)	250
Charter - Ultra100 (100 Mbps)	500
Frontier	100 / 250 in selected trial mkts
Windstream	None
SuddenLink (>30 Mbps)	350
SuddenLink (10-30 Mbps)	250
SuddenLink (<10 Mbps)	150
MediaCom - Launch (3 Mbps)	150
MediaCom - Prime (15 Mbps)	250
MediaCom - Prime Plus (30 Mbps)	350
MediaCom - Ultra/Ultra plus (50/105 Mbps)	999
Cable One – Economy	Monthly: 1GB[9]
Cable One - Preferred (50 Mbps)	Monthly: 50 GB[5]
Cable One - Elite (50 Mbps)	Monthly: 100 GB[5]

[9] Daily limits also apply. See appendix.

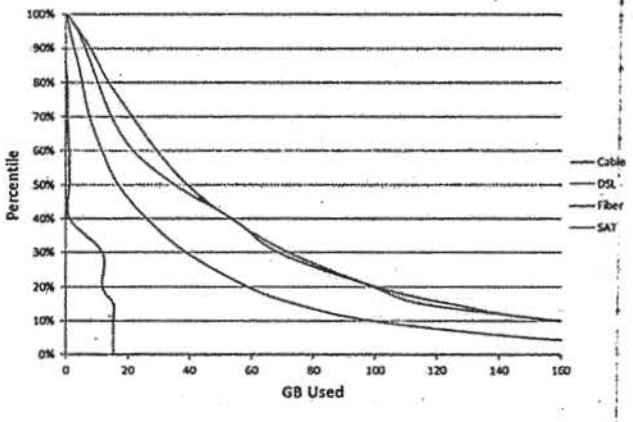
Cable One - Standard (5 Mbps)	Daily: 3 GB
Cable One - Premium (10 Mbps)	Daily: 5 GB
Cable One - Ultra (12 Mbps)	Daily: 10 GB
FairPoint	None
Cincinnati Bell	None
Google Fiber	None

Sources: See Appendix.

It is difficult to interpret even the highest thresholds in the situations in which they arise, as there is no definitive public source on household usage per month to use as a benchmark. Several different sources are available. Usage varies depending on ISP and technology. All public measurements show great skew in usage, and suggest that caps do not yet impact users other than the highest users. A first look at the usage distribution is offered by Figure 1.1., which comes from the July 2012 Broadband Report.

Figure 1.1 puts the median at approximately 15 GB for DSL, 25 GB for Fiber, and 30 GB for cable users. Other estimates vary, but are in a "similar neighborhood." For example, another estimate puts the median at 14 GB, and an average at 47 GB. (Bauer, Clark, Lehr, 2012). A Cisco study last year put the average at 26.2 GB average in 2011, with a forecast of 84 GB by 2016.

Figure 1.1. Distribution of monthly use of data



Source: http://www.fcc.gov/measuring-broadband-america/2013/February#Chart20.

In addition to data collected by various studies, it is also possible to think of caps in terms of hypothetical use rates. One committee member offered a "cord cutter" benchmark: the Internet usage equivalent of the five hours per TV per day. Consider the following: 5 hr/day (television viewing) x 2 GB/hr (high quality video) x 30 days. That would yield 300 GB/month in use. Recognize that this is a speculative simulation, and considerable variance is possible. Many factors could change the outcome at a household – e.g., DVR use with HD antenna, type of viewing, live news and sports over the air. This also does not include other Internet usage.

This leads to a number of conclusions. For one, most thresholds in wire-line today in the US appear to affect only high end users. The lack of subscriber data makes it impossible to provide an estimate of the precise percentage of users affected by high thresholds, but at this point a high threshold, such as 150-300 GB, appears to affect a small percentage of households.

Despite that, there is some evidence that caps may be binding on users, if set low enough. For example, many Canadian ISPs have set caps in the range of 25/40/60 GB per month.[10] According to Netflix, streaming video at normal or high definition quality caused users to exceed their data allowances. Netflix reported that these low caps seemed to have an effect on household demand for its services and that it observed a noticeable response in its business. The same response would have been anticipated in the best of circumstances, but it was further magnified by the poor measurement of traffic at the household level and the lack of transparency to users. In reaction to these low caps, Netflix reduced the default quality of the videos it sent to Canadian users. Netflix set a lower quality bitrate limit (625kbps vs. 4800kbps) as the default for all users, to prevent users from accidentally hitting their caps. According to Netflix, streaming of high-definition content on the ISPs that cap in Canada is essentially non-existent, and the quality of the user experience has been reduced.

Will caps within the United States ever affect more than a small percentage of US households? Here we review two perspectives.

To begin, experts disagree on predictions for the likely rate of future growth in data usage due to (expected) growth in cloud-based services and video services at the level of household and in the marketplace overall (more discussion below). Even predictions for the near future vary heavily. Committee members were familiar with predictions as low as 20% and as high as 40-50% growth per year. This report draws from Sandvine Global Broadband trends, Cisco Visual Networking Index, SamKnows, and the FCC's Measuring Broadband Report. While all such reports provide a similar outlook of the broad picture, these reports can differ significantly in the specific numbers provided.

Even this simple presentation of facts illustrates a point of disagreement between distinct perspectives. Though more will come in later sections of this report, here is a brief illustration:

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[10] The outline of these events has been reported in the trade press. See, e.g., Nate Anderson, March 29, 2011, "Data caps claim a victim: Netflix cuts streaming video quality," *Arstechnica.* http://arstechnica.com/tech-policy/2011/03/data-caps-claim-a-victim-netflix-streaming-video/, and Richard Lawler, March 28, 2011, *Engadget*, "Netflix Canada announces new bandwidth management settings for capped users," http://www.engadget.com/2011/03/28/netflix-canada-announces-new-bandwidth-management-settings-for-c/,
[10] both accessed April 28, 2013.

Some non-profit advocacy groups argue that caps will become binding assuming a constant rate of growth of bandwidth usage without corresponding cap adjustment. Some point out that "yesterday's so called "bandwidth hogs" are today's typical users."[11] A bit of simple speculation can illustrate the circumstances in which the claim is valid or not. If growth rates are at the lower end of projections, say, 20% growth rates, there would be a doubling of use in a little less than four years. With such growth rate, a 150GB cap would become relevant to the behavior of much more than 10% of cable and fiber households portrayed in figure 1.1. Additionally, advocacy groups express concern that so called "extreme" users tend to be disproportionately early adopters of new technologies, and as such, caps that affect them may prove to have a large impact on innovation in the field, independent of the sheer number of users they affected.

Suppliers counter that the highest thresholds are unlikely to ever affect more than "extreme" users. Some ISPs determine their thresholds in reference to usage—often the threshold is either explicitly set as a certain percentage of their subscriber base's usage, or is set so as to only affect an estimated percentage of the subscriber base. Under either methodology, by definition, the threshold can only affect that top percentage of users that are using the most bandwidth, and will not affect the vast majority of subscribers.[12] These thresholds are often established and periodically re-assessed, specifically to focus any effect on only the uppermost percentile of users. Therefore, by definition, these will only affect "extreme" users. For example, Comcast has raised its thresholds over time.[13] In addition, some ISPs have stated publicly that these "extreme" users tend to be those that are utilizing 24x7 file sharing or operating content or application servers from their homes. This usage pattern ties up infrastructure in a dedicated fashion that is similar to a reserved capacity of commercial service offering.

From the facts and examples listed above, we can reach only tentative conclusions. Although caps do not seem to be affecting a large number of US users now, the situation may change in the future, as user habits, supplier experimentation, vendor policy, and applications all change. As such, the FCC should monitor the situation. The committee makes no recommendation about which, of many factors, would be the most useful to monitor. Among the candidates for potential monitoring: definitions of tiers by data download limit; whether those limits are packaged with other features of a contract, such as bandwidth and speed; contractual provisions for what happens when users bump up against a tier (see, e.g., the appendix); and whether systematic differences arise across categories of service (fiber, DSL, etc).

In addition, it may be valuable to consider what warning signs of increasing effects by caps would look like. In addition, the reports about the Canadian experience with caps generally lacked verifiable data or other surveys of user response. It would be interesting to compare usage

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[11] The New America Foundation, "Capping the Nation's Broadband Future?" http://www.newamerica.net/publications/policy/capping_the_nation_s_broadband_future, accessed May, 17, 2013.

[12] For example, AT&T describes: "In fact, less than 2% of AT&T High Speed Internet users utilize more than 150GB per month. We estimate that 98% of our customers will not be affected by this change because our data plans include so much bandwidth." (http://www.att.com/esupport/article.jsp?sid=KB409045#fbid=kiJ0SSZjH9l).

[13] See e.g., Nate Andresen, May 17, 2012, "Comcast suspends 250 GB cap for now," *Ars Technica*, http://arstechnica.com/business/2012/05/comcast-suspends-data-caps-for-now/, accessed April 29, 2012.